

ART. X.—*A Dome-like Structure in the Jurassic Rocks of South Gippsland.*

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The Jurassic sediments of South Gippsland outcrop chiefly in two north-east and south-west trending horsts, and in the intervening graben, which between them comprise the major portion of the South Gippsland Highlands (1). The detailed geology of the greater part of this region is shown on a scale of two inches to the mile on the Geological Parish Plans issued by the Geological Survey of Victoria. A study of these maps, and of the boring records published by the Mines Department of Victoria, reveals that the north-eastern part of the more southerly of the two highland areas is not a normal horst or tilted fault block such as is found elsewhere in the Highlands, but a large, elongated, dome-like structure, open to the south-west, as shown in fig. 1.

The Jurassic rocks in this part of the Highlands dip outwards in radial fashion, with dips ranging from 10 degrees to 30 degrees to the north-west, north, north-east, east and south-east from a central axis extending from Blackwarry south-westwards through Balook. The change in the direction of dip across the axis of the dome is relatively sudden, and it is only near Balook that the Jurassic strata do not appear to have undergone tilting. They are nowhere horizontal. This is partly because here, as elsewhere (2), the Jurassic strata had been folded into small, irregular domes and basins of shallow closure prior to the faulting and warping movements that gave rise to the larger structure under consideration. Where such undisturbed minor folds are exposed in section, they appear as closely-spaced, impersistent anticlines and synclines, with irregular strike directions; and since good exposures of the Jurassic rocks are found only in road and railway cuttings, and in the beds and cliffs of streams, most of the available dips in an undisturbed region show an exceedingly irregular arrangement of minor folds, as, for example, in the parishes making up the south-western portion of fig. 1. Such irregular folding may be taken as an indication that the region concerned has not suffered any marked later tilting. Where tilting or warping has occurred, it is superimposed on this earlier folding, and, if strong enough, tends to produce a prevailing, though fluctuating, dip in the direction of the tilt or warp. This is the case in the region now under consideration.

A further measure of the tilting and warping that has affected the South Gippsland Highlands is provided by the disposition of the Tertiary basalts and gravels that overlie the Jurassic at

many places. The manner of occurrence of these Older Volcanic basalts was originally similar to that of the Newer Volcanic basalts forming the plains west of Melbourne. The Older Volcanic basalts infilled valleys in the pre-basaltic land surface, and then formed a wide, more or less horizontal, sheet covering the infilled valleys, so that while the original under surface of the basalts was not level, for structural purposes it approximated to a horizontal surface. Warping or tilting of this approximately horizontal surface is readily detected from the disposition of the basalt residuals in any given area. This may be seen, for example, from the Geological Parish Plan of Moe, where the main area of basalt slopes southwards at about 1 in 40, while along the Yarragon Scarp, the same basalts have been tilted steeply to the north (3).

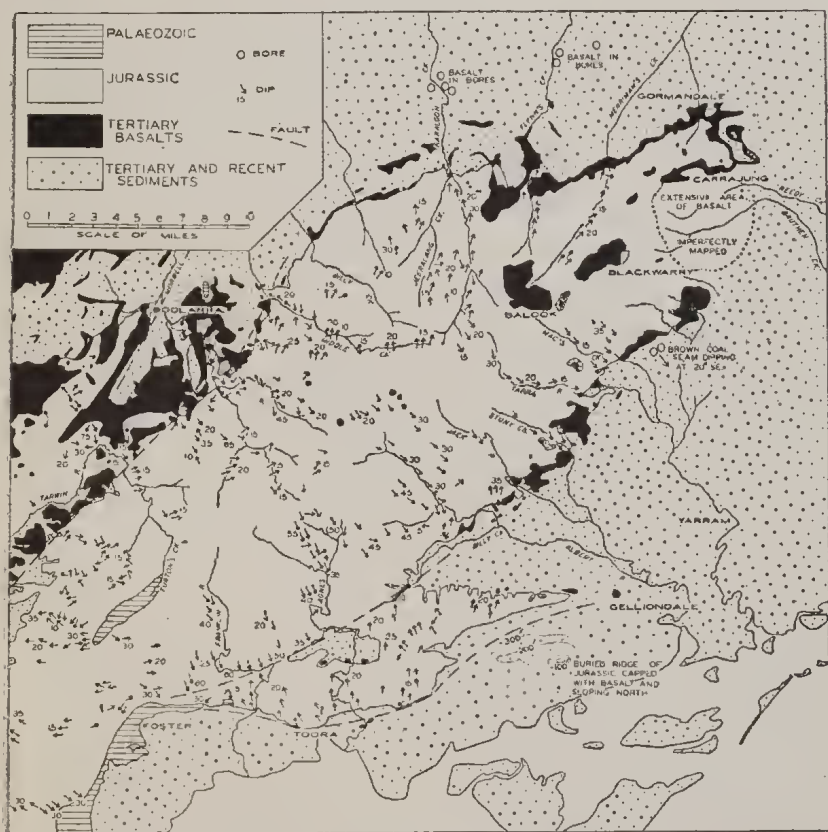


FIG. 1.—Sketch map of the Balook Dome, South Gippsland, showing the localities referred to in the text. Geology based chiefly on the Geological Parish Plans of the Geological Survey of Victoria.

In the region under consideration, basalts occur as a fringe of outward-dipping, tilted residuals enclosing the Jurassic on three sides (fig. 1), while in the vicinity of Balook, on the axis

of the dome, they form a horizontal residual, overlying bedded gravels. Between Blackwarry and Carrajung are further residuals which show a gentle slope to the north-east. The disposition of the basalt thus provides clear evidence of the dome-like form of the structure.

This dome-like structure, which may be described for convenience as the Balook Dome, is marked off from the plains to the north and south by scarps, which have been attributed tentatively to faulting (1), the Carrajung Fault on the north, and the Won Wron Fault on the south-east. The records of bores put down in the adjacent Brown Coal areas indicate, however, that the scarps arise from warps, or relatively gentle monoclinal folds, rather than from faults, although these folds appear to pass into faults when traced to the south-west.

Along the northern flank of the structure, bores in the parishes of Traralgon, Loy Yang and Tong Bong (4, 5), show tilted basalt and overlying brown coal seams at first passing slowly to increasing depths, and then flattening. The basalt has been traced in the bores for a distance of nearly two miles north of where it ceases to outcrop, with a downward slope of only two or three degrees. The position of these bores is shown on fig. 1, but it is possible that the basalt may continue further north, since the bores in that part of the area have not penetrated sufficiently deeply to establish its absence.

Along the south-eastern margin of the Balook Dome, most of the bores on the plains are too shallow to penetrate through the outwash sands to the underlying basalt, but in the Parish of Won Wron, a series of bores have revealed a seam of brown coal about 100 feet thick, which overlies the tilted basalt, and dips to the south-east at an angle to about 20 degrees beneath a mantle of outwash material (6). Further to the south-east the Tertiary beds presumably become horizontal again, since marine Miocene beds which are exposed in a large washout on Bruthen Creek, several miles above Woodside township, are horizontally disposed. While it is not known that the brown coal passes under this actual outcrop, related brown coals underlie similar Miocene beds at considerable depths in bores along Merriman's Creek, some miles to the north. The evidence at Hedley indicates that the faulting and warping movements here described are of post-Pliocene age (7), and no evidence has been found to suggest that any earlier Tertiary earth movements have affected the area.

ORIGIN OF THE STRUCTURE.

When the northern monocline is traced south-westwards, it passes into a definite fault somewhere in the vicinity of Boolarra. From the evidence available, the actual point of transition cannot be fixed, but the change from irregular dips along Middle Creek, to a prevailing northerly dip further to the north-east,

suggests that the fault extends as far north as the point where Middle Creek leaves the scarp. The marked increase in the width of the basalt areas north-east from Billy Creek also points to the transition occurring near this point. The southerly monocline appears to continue as such until it is west of the Albert River, where a certain amount of minor folding is associated with it. From this point it begins to converge on the well-marked Gelliondale Fault, the two approaching each other in the vicinity of Foster, as shown in fig. 1. Certain other smaller faults shown by Hills (1), and on the Geological Parish Plan of Toora, appear to be non-existent. Between the Albert River and Foster the southerly monocline passes into a fault, and pronounced drag is shown in the Jurassic strata exposed along the east-west section of the Franklin River, where dips as great as 80 degrees south are found. The Toora Fault Block, lying between the Gelliondale Fault to the south and this Won Wron Fault and Monocline to the north, is tilted to the north at an angle of about 5 degrees (the steepest dips on this block rarely exceed 25 degrees north), and several small areas of basalt, overlain by Tertiary sands and gravels, are preserved on this block, close to the fault angle between it and the main horst to the north.

The Toora Block is much narrower than the main highland block, and much lower, so that the Agnes River and the Franklin River, having turned and followed the fault angle for some distance, were able to escape over the Toora Block to the south. Where they cross its scarp, they have developed prominent waterfalls with gorges downstream, from which they emerge to the narrow coastal plain on the downthrow side of the Gelliondale Fault. Both these rivers turn eastwards along the fault angle, suggesting that it sloped to the east, and the southern Billy Creek also flows along the fault angle in this direction, further to the east. There does not appear to have been any connexion between these streams.

Basalts outcrop alongside the Agnes River, south of the Toora Block; and in the Parishes of Alberton West, Welshpool and Toora, a number of bores have penetrated to the Jurassic of the downfaulted block south of the Gelliondale Fault (4) (5). The Jurassic rocks in the bores are capped in places by Tertiary basalts (6), and occur as a ridge whose surface slopes to the north at about 1 in 15, and rises to within a few feet of the surface near the central part of Alberton West (fig. 1). The failure of the Jurassic rocks to outcrop south of this point suggests that another step-fault, more or less parallel to the Gelliondale Fault, may exist in this vicinity.

Not only do the monoclines pass into faults when traced westwards, but the thickness of the Jurassic rocks decreases in this direction, and Palaeozoic sediments are exposed in the vicinity of Foster and Toora in the south, at Turton's Creek in the centre

of the horst, and north-east of Boolarra, near its north-western margin (fig. 1). It seems possible that the change from warping to faulting in the Jurassic rocks is related to this decrease in thickness. Faults which developed in the Palaeozoic basement continued upwards through the Jurassic rocks where they formed a relatively thin cover over the Palaeozoic sediments; but further eastwards, as the thickness of the Jurassic sediments increased, and the amount of fault movement decreased, the faults died out upwards into monoclinal sags; and owing to the relatively strong nature of the Jurassic strata, the sagging was spread over a considerable horizontal area, thus giving rise to a dome-like structure opening to the south-west.

Drainage.

The main streams of the domed region—Middle Creek, Northern Billy Creek, Jeeralang Creek, Traralgon Creek, Flynn's Creek, Merriman's Creek, Reedy Creek, Bruthen Creek, Mac's Creek, Tarra River, Stony Creek, Jack Rivulet, and Albert River, appear to be consequent streams, developed after the warping, so that they radiate from the central axis of the dome (fig. 1). They are all dip-streams over most of their courses, and this character is reflected in the frequent rapids and cascades that occur where the stream beds coincide with the surfaces of beds of hard sandstone. Their valleys are deep, and steep sided.

In places along the axis of the dome, as on the basalt area near Balook, and along the upper stretches of some of the main interfluvies between the radial streams, dissection has progressed relatively slowly, giving rise to upland areas whose shallow valleys are in striking contrast to those of the deeply dissected marginal areas of the dome. The transition from the uplands to the deeply dissected country is often abrupt, and the upland streams frequently join the tributaries of the main streams across waterfalls.

References.

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